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Agency / Organization

State of New Jersey Department of Health

Title

Vinyl Chloride Exposure Study of the Community and Local Emergency Responders

Survey Methods

Two surveys of households were conducted. The **In-Person Survey** was conducted door-to-door by trained interviewers from ATSDR/CDC and NJDOH. This survey was targeted to residents of randomly selected census blocks in Paulsboro. To ensure that *all* Paulsboro residents had an opportunity to participate, the **Mailed Survey** was a self-administered questionnaire sent to all postal addresses in Paulsboro.

The population of Paulsboro is estimated to be 6,152, according to the U.S. Census Bureau's American Community Survey 2007-2011 5–Year Estimates. The total number of households (occupied housing units) is estimated to be 2,237.

In-Person Survey

Population Surveyed Because more residents were potentially exposed than could be interviewed in a brief period, ATSDR and NJDOH developed a household sampling strategy based on the Community Assessment for Public Health Emergency Response (CASPER) Toolkit. Paulsboro was divided into four Areas for sampling (Figure 1):

Area A: evacuated at some time on November 30;
Area B: evacuated on December 4;
Area C: never evacuated but immediately adjacent to areas A or B; and
Area D: remaining areas of Paulsboro that were never evacuated.

Census blocks within each zone were randomly selected for in-person surveying; the chance of a block being selected was weighted by the number of housing units on the block. Forty blocks were targeted for surveying, including 10 each from Areas A, B, C and D. On each targeted block, the objective was to survey seven randomly chosen households. Targeted blocks were visited a minimum of three times, unless seven household surveys were completed in fewer visits.

Time Frame The In-Person Survey asked about experiences during the approximately one-week period between 7:00 am on Friday, November 30 and 12:00 noon on Friday, December 7, 2012. The In-Person Survey was conducted beginning on Friday evening, December 14, through Friday, December 21, 2012.

Survey Instrument The investigation team from ATSDR/CDC and NJDOH adapted the existing Assessment of Chemical Exposure (ACE) protocol, which had been developed by ATSDR for use in post-emergency evaluations of public health impact of chemical releases.

Outreach, Participant Recruitment, and Interviewing Procedures ATSDR/CDC and NJDOH surveyors were dispatched to targeted blocks to recruit participants for the survey. Once at the targeted block, surveyors went to the designated houses to describe the purpose of the survey and ask for agreement to participate. The household section of the survey was then completed for the household by one adult member. Individual adult/adolescent surveys were then completed by either the one respondent or each individual. The adult respondent completed the survey for any children less than 13 years of age.

Mailed Survey

Population Surveyed The target population identified by NJDOH for the Mailed Survey was *all households* in Paulsboro, defined as residential postal delivery units.

Time Frame The Mailed Survey asked about experiences from Friday, November 30 through Friday, December 7, 2012.

Survey Instrument NJDOH further adapted the ACE questionnaire so that it could be self-administered by Paulsboro residents, rather than administered by a trained interviewer. This self-administered questionnaire was intended to be completed by one household representative on behalf of all household members.

Outreach and Participant Recruitment The Mailed Survey was sent to all postal delivery addresses in Paulsboro on or about December 27, 2012, together with a cover letter, informational materials, and a postage-paid return envelope. Households that completed the In-Person Survey were asked not to complete the Mailed Survey, as their responses had already been recorded. NJDOH requested households to return completed surveys by January 20, 2013.

Survey Results

A total of 154 households participated in the In-Person Survey, distributed fairly evenly across the four Areas A-D (Table 1). From the 154 households, surveys were completed for 459 individuals (Table 2). A total of 580 households participated in the Mailed Survey, including 16 that also participated in the In-Person Survey (Table 1). Surveys from these 580 households reported on the experiences of 1,511 individuals (Table 2).

A total of 718 households participated in either survey (Table 1), which is about 32% of all Paulsboro households. Similarly, the surveys collected information on a total of 1,930 individuals, which is about 31% of all Paulsboro residents (Table 2). The demographic profile of survey participants was generally similar to the town overall.

More than 260 participants in the In-Person Survey reported evacuating the area, either through official action or on their own. In the Mailed Survey, 63 households reported being evacuated, and another 73 households reported that they were not evacuated but left the area anyway. Of those who evacuated or left, most reported leaving on the day of the incident (November 30) or on December 4.

A high percentage of participants in the two surveys reported smelling or tasting an unusual odor in the air in relation to the incident. Vinyl chloride gas is said to have a mild, sweet odor. Health effects may occur from exposure to vinyl chloride at concentrations below the odor threshold.

Reported New or Worsened Symptoms

Overall, 58% of participants in the In-Person Survey and 66% in the Mailed Survey reported experiencing *new or worsening symptoms* in the week-long period after the train derailment and vinyl chloride release (Table 3).

The most commonly reported symptom or symptom groups were headache, upper respiratory symptoms (predominantly irritation of nose or throat), and coughing. Other common symptoms included: neurological symptoms (predominantly dizziness or lightheadedness), eye symptoms (mostly irritation of the eyes) and lower respiratory symptoms (mostly difficulty breathing). Participants in the Mailed Survey consistently reported somewhat higher symptom frequencies than participants in the In-Person Survey (Table 3).

The symptoms that were more commonly reported are consistent with what is known to occur from exposure to vinyl chloride, specifically headache, irritation of the eyes, nose, throat and lungs, coughing, nausea, and dizziness or lightheadedness. All of these symptoms have multiple causes, and many may occur as a result of anxiety, fear or stress induced by traumatic events.

Symptoms were more frequently reported by those with pre-existing respiratory health problems (asthma and COPD) and among those who were current smokers. Those who reported smelling odors associated with the vinyl chloride leak reported symptoms more frequently. Symptoms were most commonly reported from evacuated areas and the area within one block of evacuated areas, and were least frequent in areas farther than 3,500 feet from the derailment incident location.

Symptoms by Existing Health Conditions In both surveys, among those with existing asthma, there was a higher frequency of respiratory symptoms, including specific symptoms associated with asthma (difficulty breathing, chest tightness, and wheezing). Those with COPD also had higher frequencies of respiratory symptoms. Current smokers reported higher respiratory symptom frequencies than former smokers and the overall participant group.

Symptoms by Taste and Odor Among those who reported smelling or tasting an odor there was a higher frequency of reported new or worsening symptoms. In both surveys, the most frequently reported symptoms among those who smelled an odor were headache, coughing, and irritation of nose and throat, dizziness, irritation or pain or burning of eyes, and difficulty breathing.

Symptoms by Area In both surveys, for most symptoms, the area with the highest percentage of participants reporting the symptom was Area C (census blocks never evacuated but immediately adjacent to blocks that were evacuated). Area D (the remaining non-evacuated census blocks) had the lowest percentage of participants who reported symptoms in both surveys.

Symptoms by Distance from the Derailment Site In both surveys, symptom frequencies are consistently higher in homes closer than 3500 feet from the incident site than those farther than 3500 feet. In the In-Person survey, most reported symptoms peaked in the 2501 to 3500 feet distance, not in the area closest to the derailment site. In the Mailed Survey, the symptom frequencies were fairly consistent in the three distance bands within 3500 feet, although a majority of symptoms had slightly higher frequencies within 0 to 2500 feet from the derailment site.

Reported Medical Care

In the In-person Survey, 10 individuals (2%) reported being provided medical care by an emergency medical technician or paramedic; 40 individuals (9%) reported going to a hospital emergency room; and 22 (5%) sought medical care elsewhere for health concerns in relation to the incident. Similarly, in the Mailed Survey, 15 households (3%) reported that someone in the household received medical care from an emergency medical technician or paramedic; 67 (12%) had a household member who went to a hospital emergency room. Twenty-two percent of households in the Mailed Survey sought medical care elsewhere for health concerns in relation to the incident.

In the Mailed Survey, the percentage of households in which someone received care at a hospital decreased with distance from the train derailment site. Twenty-one percent of households within 1,500 feet of the derailment reported that someone from the household went to a hospital.

Communications

Most adults first heard of the incident from a relative, friend, neighbor or coworker; most adults first learned about what to do from persons in authority, television or friends, neighbors and co-workers. The results of the surveys demonstrated that the network among

families, neighbors, friends and co-workers in Paulsboro was crucial in the initial communications regarding the incident. While most adults continued to receive information regarding the incident from the television, most respondents indicated the best method for receiving additional information would be through direct communication from a person in authority (including officials going door to door or reverse 911 telephone calls).

Table 1. Number of Paulsboro *households* participating in In-Person Survey or Mailed Survey.

Number of *households* participating in In-Person Survey Area A Area B Area C Area D Total	 38 35 41 40 154
Number of households participating in Mailed Survey	580
Total number of households participating in either survey *	718
Estimated number of households in Paulsboro **	2,237
Estimated *household* participation rate in either survey	32

* 16 households participated in both surveys but are only counted once in this total.

** Based on American Community Survey 2007–2011 total households estimate for Paulsboro (U.S. Census 2012).

Table 2. Number of *individuals* from Paulsboro households participating in In-Person Survey and Mailed Survey.

Number of *individuals* in households participating in In-Person Survey Area A Area B Area C Area D Total	 112 114 126 107 459
Number of individuals in households participating in Mailed Survey	1,511
Total number of individuals participating in either survey *	1,930
Estimated number of individuals in Paulsboro **	6,152
Estimated *individual* participation rate in either survey	31

* Of 16 households that participated in both surveys, there were duplicate reports for 40 individuals, so these are excluded from the total number of individuals.

** Based on American Community Survey 2007–2011 total population estimate for Paulsboro (U.S. Census 2012).

Table 3. Symptoms reported to be experienced by individuals.

Symptom or Symptom Group	In-Person Survey Number and Percent of Individuals		Mailed Survey Number and Percent of Individuals	
	#	%	#	%
No symptoms reported	*193*	*42*	*517*	*34*
HEADACHE	**161**	**36**	**719**	**48**
EYE SYMPTOMS	**100**	**22**	**531**	**35**
Irritation/pain/burning of eyes	85	19	467	31
Increased eye tearing	64	14	331	22
UPPER RESPIRATORY SYMPTOMS	**152**	**34**	**658**	**44**
Irritation of nose or throat	125	28	559	37
Runny nose	82	18	330	22
Nosebleed	3	1	105	7
INCREASED CONGESTION OR PHLEGM	**85**	**19**	**344**	**23**
COUGHING	**139**	**31**	**574**	**38**
LOWER RESPIRATORY SYMPTOMS	**113**	**25**	**495**	**33**
Difficulty breathing/feeling out of breath	82	18	371	25
Chest tightness	51	11	275	18
Wheezing in chest	51	11	244	16
Irritation of lungs	52	12	233	15
GASTROINTESTINAL SYMPTOMS	**79**	**18**	**393**	**26**
Nausea	75	17	380	25
Vomiting	35	8	125	8
NEUROLOGICAL SYMPTOMS	**125**	**28**	**563**	**37**
Dizziness or lightheadedness	89	20	412	27
Sleepiness	72	16	320	21
Generalized weakness	31	7	128	8
Blurred or double vision	24	5	116	8
Loss of balance	24	5	111	7
Numbness or tingling in the arms or legs	31	7	100	7
Confusion	23	5	85	6
OTHER SYMPTOMS	--	--	--	--
Palpitations or fast heart rate	29	6	110	7
Ringing of the ears	23	5	95	6

Figure 1. Maps of Paulsboro showing Survey Areas A through D, and distance in feet from the train derailment location.